Prof. Bunsen, by the employment of different metals from those hitherto tried, found that he could increase the strength of the current, and M. Marcus, of Vienna, using alloys instead of simple metals for the positive and negative element, reduced the cost, while increasing the power of the battery. From a thermo-electric battery constructed on his principle, and also from a modified form, devised by Wheatstone, a current sufficiently strong to produce brilliant sparks, decompose water, &c., was obtained. This was in 1865, and but little progress has, until now, been made in this branch of science, with the exception of the improved forms of thermo-pile devised by Noë and by Messrs. C. and L. Wray, although the utilisation of heat—especially solar heat—for the production of electricity has long attracted the thoughts of many experimenters.

M. Clamond has for some time been at work upon the subject, and has so far succeeded that his thermo-electric battery has been employed since 1875 in M. Goupil's factories. These batteries are formed of iron, as the electro-positive element, and an alloy of antimony and zinc for the negative; they are soldered together and arranged in a circular form, which can be built up as high as may be desired. The junctions of the metals are heated in the interior, but the electromotive force being proportional to the difference of temperature between the two extremities of each bar, it was necessary to make the bars long if a strong current was desired, and then the results were less satisfactory, owing to the increased internal resistance, the melting of the metals where they were soldered, &c.

It is these hindrances to its extended use which M. Clamond has sought to obviate in his latest form of battery, which is composed of three distinct parts. The *collector* consists of a number of pieces of cast-iron so arranged that the heated air can circulate within them; a large surface is thus exposed to the heat, which the iron collects and communicates to the couples. The *diffuser* is the outside of the apparatus, and is made of sheets of metal. The *thermo-pile proper* is placed between these two, and is so arranged that the junctions of the metals are alternately at the temperature of the collector and the diffuser. Heat passes from the collector to the diffuser along these couples, which have no great length. In some forms which are very easily worked, a number of these couples are made into a flexible chain of any desired length, the extremities forming the poles of the battery. These chains, insulated from the other parts of the apparatus, can be united to each other by their free ends, so that a variety of couplings and combinations may be made. The model now in use for lighting a workshop in Paris is about 2½ metres high, and 1 metre in diameter, the exterior form being that of a polyhedron, to the sides of which the thermo-electric chains are attached; these are composed of small cubes of zinc and antimony joined together by plates of tin, to which they are soldered. Each half of the apparatus has 30 chains of 100 couples each, or 6,000 couples in all. To the outer surface of these chains are fixed the sheets of copper which form the diffuser or heat distributor.

Another model, made for the recent exhibition at the Albert Hall of the various systems of electric lighting, is square and much smaller, though of the same power.

Each half of the cylindrical battery can be made to supply a powerful electric light, while the square one can produce *four* lights of half the brilliancy. The electromotive force is, according to prolonged experiments, 218 volts, about equal to 120 Bunsen cells, while the resistance is 31 ohms. The large battery consumes only 9 or 10 kilogrammes of coke an hour, and the smaller one even less, about 6½ kilogrammes. Moreover, the large exterior surface of the apparatus radiating its heat to the air around adapts it admirably for use in heating, as well as for lighting, and it can thus be made to serve the double purpose of giving warmth and light.

M. Sudré has also designed his thermo-pile with a view to obtaining one of small volume and having a low internal resistance; the other peculiarities of his battery consist in the manner in which one set of junctions are heated while the other set are cooled. He has also determined what is the best length for the bars forming the couples, in order that the necessary difference of temperature at the two extremities may be maintained, while yet making them as small as possible. This he finds should be from 10 to 30 millimetres, according to the difference of temperature required. His manner of soldering together the two different metals is also novel and ingenious. In order that contact may be made with the whole surface of the bar, he cuts the plate, forming one metal, into the shape of a comb, twisting the teeth of this comb together, thus retaining a large surface, which yet has only a short length. The bars are fastened on to these twisted parts and the uncut part of the plate is coated with silicate of soda. The couples are formed in a mould in which the plates are fixed, the melted alloy is then run into the mould so that a block is formed of the alloy and the plates, firmly united. These chains or blocks are then placed between two plates, coated on one side with enamel or other electrically insulating substance; several chains may thus be arranged side by side, each chain being both calorically and electrically insulated. The parts of the chain are electrically insulated by the thickness of the plates, but heat can flow across the couples. The chains are next placed between a collector and a diffuser; the collector is ribbed if the source of heat be gas, in order to expose a greater surface. The diffuser is also ribbed for the same reason when the heat is merely allowed to radiate into the air. The whole battery is so arranged that the collectors form the inside of a circle within which the heated air is circulated.

BIOLOGICAL NOTES

THE BLOOD OF THE LOBSTER.—This liquid has been recently examined by M. Fredericq (Belgian Academy's *Bulletin*, No. 4), whose researches on the octopus were recently published. He finds in it as a rule two colouring matters, one blue, an albuminoid, coagulated by alcohol and heat, and apparently identical with the *hæmocyanine* found in the blood of the octopus; the other of rose colour, and soluble in alcohol (not always present). The former loses its blue colour in vacuo, and recovers it when acted on by oxygen, and it contains copper. The blood of the lobster is rose when it is reduced; exposed to oxygen it takes a special tint, blue with reflected light (hæmocyanine), brown with transmitted light (rose matter). It coagulates spontaneously and therefore contains fibrine. The blood of certain Gasteropoda (*Arion, Helix*) is also found to contain hæmocyanine, whereas M. Fredericq has not found it in the Lamellibranchiata (*Unio, Anodonta*). The general conclusion is reached that in such different groups of invertebrates as cephalopod and gasteropod molluscs, crustacea and annelids, as well as in vertebrates, respiration is effected by means of metalliferous proteic substances (hæmoglobin, hæmocyanine, chlorocruorine) which form in the respiratory organ (branchia, lung) less stable oxygenated combinations. These latter are dissociated in their passage through the tissues. In invertebrates, the two great functions of the blood, respiration and nutrition of tissues, belong both to the plasma, the corpuscles having a quite accessory importance. In the blood of vertebrates there is, in this respect, a division of physiological work; the respiratory function devolves upon the corpuscles, the nutritive function on the plasma.

ANNELIDS OF THE VIRGINIAN COAST.—Mr. H. E. Webster has just published an account of the Annelida Chætopoda which were collected in the summer months of 1874 and 1876 by the zoological expeditions sent out

under the auspices of Union College, Schenectady, N.Y. (in advance of vol. ix. of the *Transactions* of the Albany Institute, pp. 1-72, plates 1-11). The locality was on the eastern shores of Virginia (Northampton); between the mainland and the islands a large area of dark mud is exposed at low water. It is described as abounding in animal life, and yet the number of species of Annelids described is not large, there being only fifty-nine, relegated to forty-nine genera; of these, four of the genera are new, and twenty-seven of the species. The absence of Mediterranean species seems noteworthy, scarcely any of Ehler's species from the Adriatic or Claparède's, from the Bay of Naples, being quoted.

ACID REACTION OF FLOWERS.—It was stated, as the result of observation, by MM. Fremy and Clöez, that the juices of all red and rose-red flowers showed an acid reaction, whereas the juices of blue flowers were always neutral, or even weakly alkaline. The subject has been studied afresh by Herr Vogel, who examined 100 species, viz., 39 blue, 44 red, 6 violet, 8 yellow, and 3 white flowers. The experiments (described to the Munich Academy) confirm the view that it is not warrantable to attribute the red colouring of flowers to action of acids or acid salts on blue colouring matter, or to attribute the latter to the influence of alkalies on red colouring matter, though doubtless there is a certain relationship between certain red and blue plant colours. It further appears that the opinion that plant juices generally, and even the majority of flower-juices, have an acid reaction, is pretty correct; among 100 flowers there were only twelve which did not react acidly. On the other hand, the rule above referred to is not found to apply universally, for among thirty-eight blue flowers twenty-eight showed a decidedly acid reaction, though the degree of the acidity was less than in red flowers.

FUNCTION OF SOME CONTRACTILE VACUOLES IN INFUSORIA.—An observation recently published by Herr Engelmann, of Utrecht, throws light on the function of the contractile vacuole in some infusoria. Some time ago he found a new infusory animal, closely allied to *Chilodon cucullulus*, and which he calls *Chilodon propellens;* it is marked by its slender form, and by the round shape of its hinder extremity, where is the contractile vesicle. This animal swims with pretty constant, but very slow, velocity in circling paths. Each time the vacuole contracts (which occurs in pretty regular intervals of about half a minute, and very quickly) there is an impulsive acceleration of the forward motion. If the animal be at rest, it makes, at the moment of systole, an impulsive forward movement about a quarter of its length. No simultaneous acceleration of the very sluggish ciliary movement was observed. The forward motion, then, can only be attributed to the backward thrust of liquid expelled from the contractile vacuole. Herewith agrees the fact that the hinder portion of the body shrinks together, in systole, as though to a thin empty sack folded in longitudinal direction, without the least perceptible increase in volume of the forepart of the body; so that the greater part, if not the whole of the liquid contents of the vacuole, must have been ejected behind. The re-expansion of the vacuole takes place very slowly, and it could not be determined whether liquid was directly drawn in from without. Coloured liquids were never observed to enter the vacuole.

PHYSIOLOGICAL ACTION OF COPPER.—For some years past the majority of medical men have no longer considered salts of copper as true poisons, their innocuousness being partly due to the fact that when they are taken in any considerable quantity, they cannot be kept in the stomach, but produce vomiting. It remained to ascertain whether, in animals incapable of vomiting, salts of copper would act as poison. At a recent meeting of the Société de Biologie, M. Gallipe described some experiments on the subject. He had given several rabbits copper with their food. One of these animals received daily, for six months, two grammes of acetate of copper. At the end of this period, the rabbit showed considerable fattening. Its liver weighed 70 grammes, and contained 13 centigrammes of copper. Further, this rabbit was eaten by the experimenters, who were no way incommoded thereby. This is one fact more (says *La Nature*) in favour of the so-called rehabilitation of copper.

LOCALISATION OF ARSENIC IN THE BRAIN.—Experiments have recently been made on guinea pigs by M. De Poncy and Livon (*Comptes Rendus*), with reference to the localisation of arsenic in the brain, when arsenious acid was given in small doses daily with the food. They found that phosphoric acid increased considerably in the urine, and it can only have come (the authors point out) from an elimination by substitution, not from a pathological state of the animal, for in cerebral affections, rather a diminution than an increase of phosphoric acid in the urine has been observed. The arsenic, then, seems to replace the phosphorus of phosphoglyceric acid in lecithine, producing arsenioglyceric acid. The authors are seeking to isolate this new base.

NOTES

PROF. CHRYSTAL of St. Andrews (formerly of Peterhouse, Cambridge) has been appointed to the Chair of Mathematics in Edinburgh University. He was Second Wrangler and Second Smith's Prizeman in 1875, and is already known to science by his experimental researches on Ohm's Law (made in the Cavendish Laboratory) and by the very excellent article "Electricity" in the new edition of the *Encyclopædia Britannica*. Among the eleven candidates for the chair there were four Senior Wranglers. Thus the Chair of Mathematics in St. Andrews is now vacant; and it has just been announced that Prof. Blackburn has requested the University Court of Glasgow to sanction his retirement from the Chair of Mathematics there. As Prof. Fuller of Aberdeen resigned last year only, the whole of the Mathematical Chairs in Scotland have been vacant within one year.

AT the half-yearly general meeting of the Scottish Meteorological Society, held on Monday, July 21, papers were read on "The Cold Weather since November, compared with Periods of Protracted Cold in Scotland from 1764," by Alexander Buchan; on "The Great Plague of London in Relation to Weather," by Dr. Arthur Mitchell; and on "Ground Swells observed in Scotland since 1868," by Alexander Buchan. With reference to the proposal of General Myer to publish maps exhibiting the simultaneous monthly means in meteorology of the whole of the northern hemisphere, intimated in NATURE, vol. xx. p. 275, the Scottish Meteorologists state, in their Report to the meeting, their conviction "that this truly cosmopolitan work, which the United States alone are in a position to undertake, thanks to the enterprise and liberality of their Government, will bring before us, month by month, the general circulation of the earth's atmosphere, and raise at least, if not satisfy, many inquiries lying at the very root of meteorology, and intimately affecting those atmospheric changes which meteorologists hitherto have been recording."

WE have already referred to the valuable "Bibliographical Contributions" issued by the library of Harvard University and edited by Mr. Justin Winsor, the librarian. One of the most scientifically important of these is a list of apparatus available for scientific researches involving accurate measurements, prepared by means of answers to a circular sent out by Professors Wolcott Gibbs, E. C. Pickering, and Trowbridge, of Harvard. This circular speaks of the cost of the apparatus required for exact quantitative determinations in the various branches of